Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
	)	
Amendment of Part 90 of the	)	**PR Docket No. 93-61**
Commission's Rules to Adopt	)	
Regulations for Automatic	)	**RM-8013**
Vehicle Monitoring Systems	)	
	)	

To: The Commission

PETITION FOR RECONSIDERATION

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April 24, 1995

EXECUTIVE SUMMARY

MobileVision, L.P. ("MobileVision") supports the issuance of permanent rules to replace the interim status of prior rules governing Location Monitoring Services ("LMS") (previously known as Automatic Vehicle Monitoring or "AVM"). The record in this proceeding is voluminous and the comments of the various interest groups are diverse. In several significant areas, MobileVision believes that the compromises reached by the Commission are injurious to the LMS providers at whose request the proceeding was initiated and contrary to the interests of "promoting the efficient operation and continuing growth" of LMS systems, the predicated objective of the rulemaking.

Rather than allow the market to define the permitted services of LMS, the Commission has elected to restrict the content and means of voice and data communications that are allowed by subscribers of the licensed services. In limiting the content to a vague and unenforceable standard defined as "status and instructional" messages, the Commission has limited consumer choices, impacted the viability of LMS systems and significantly reduced the ability of these systems to contribute to the accomplishment of national goals for Intelligent Vehicle Highway Systems ("IVHS") and Intelligent Transportation Systems ("ITS"). By severely restricting interconnection between licensed LMS subscribers and the PSN, restrictions that do not apply to unlicensed Part 15 users, the rules cripple the ability of LMS consumers to utilize the services when they require, placing in doubt the commercial viability of the systems, and at the same time placing LMS providers at an unfair competitive disadvantage to hybrid systems (e.g., GPS/cellular) as well as Part 15 systems.

The Commission sought to avoid an undue hardship in adopting grandfathering rules that would recognize the effort and investment among the current licensees. Those rules should, however, be amended to permit additional transmit sites within the grandfathered coverage area in order to satisfy requirements of reliability, quality and accuracy for the grandfathered LMS services.

MobileVision (and the other multilateration LMS providers) believe that the emission mask requirements contained in the Report and Order are virtually impossible to obtain due to the nature of the services offered and have proposed an alternative standard in Annex I to this Petition.

Lastly, MobileVision asserts that the technical standards adopted as a presumption of non-interference for unlicensed Part 15 device use within the licensed LMS bands are based on incorrect conclusions. In addition to suggesting alternative standards to be used for that purpose, MobileVision urges that any such presumption must be rebuttable. Otherwise, the established priority of licensed LMS providers over unlicensed Part 15 users will have been improperly upset.

TABLE OF CONTENTS

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In the Matter of	)	
	)	
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INTRODUCTION

MobileVision, L.P. ("MobileVision"), by its attorneys and pursuant to 47 C.F.R. § 1.429, hereby submits this petition for reconsideration of certain aspects of the Report and Order ("Order") in the above-captioned proceeding released on February 6, 1995. MobileVision applauds the release by the Commission of permanent rules governing Location and Monitoring Service ("LMS") and recognizes the difficulty the Commission faced in crafting these rules given the extensive record with regard to the issues and the diversity of opinion reflected in the proceeding. MobileVision believes, however, that the Order only partially recognized the needs of LMS providers, as set forth in that record, that must be met if the public is to receive the exciting and valuable benefits of LMS. As a result, MobileVision believes that the following aspects of the rules require changes to ensure viable LMS service and that adoption of the amendments proposed herein to reflect those changes will further the Commission's objectives and the public interest with regard to providing LMS:

- Permitted Uses -- The Order unduly restricts the services that can be provided by LMS providers and inhibits the manner in which they are to be provided. These limitations will affect the range of services available to the consumer and business user with anti-competitive effects and will impact significantly, even critically, on the viability of providers and their interest in participation in subsequent auctioning of spectrum.

- Grandfathering Provisions -- These provisions unfairly restrict effective deployment in a coverage area provided by existing licenses that are to be grandfathered.

- Part 15 Interference and Status -- The Commission has taken an unprecedented step in elevating the status of Part 15 users to co-equal with licensed users in the band without adequate notice and a rulemaking proceeding directly relevant to the issues. In fact, the Commission's Order actually requires that the licensed users demonstrate their compatibility with the unlicensed users. The Rule should be modified to create rebuttable presumptions of non-interference and maintain the prior hierarchy within the band.

- Emission Mask -- The Commission has mandated technical restrictions with regard to out-of-band emissions that are not practicable if not impossible for LMS systems to meet.

I. THE COMMISSION SHOULD BROADEN THE PERMITTED USES OF MULTILATERATION LMS

The basic and laudable objective set forth in the Proposed Notice of Rulemaking ("NPRM") in this proceeding was to develop "rules that will promote the efficientoperation and continuing growth of [LMS] systems." (Notice ¶ 1). The Order falls short of reaching that objective by imposing restrictions on the content and availability of voice and data communications that may be used by service subscribers. The effect of these limitations will be to weaken the alternatives available to the marketplace, forcing the consumer that desires a combination of location service and occasional but unrestricted voice or data communications to seek a more costly substitute. Nor do the permitted uses as defined in the Order adequately provide for the requirements of Intelligent Transportation Systems (ITS).

A. Status and Instructional Messages

The new § 90.353(a)(2) provided by the Order limits LMS systems to the transmission of "status and instructional messages, either voice or non-voice, so long as they are related to the location and monitoring functions of the system." MobileVision contends that this definition is too restrictive to permit viable LMS services, is vague and ambiguous, will prove

difficult to regulate and will hinder LMS providers from providing the services required by ITS and other potential future uses.

The Commission clearly recognizes the value of the LMS contribution.

> "It is expected that in the coming years both types of LMS systems [multilateration and non-multilateration] will play an integral role in the development and implementation of the variety of radio advanced transportation-related services, known as 'Intelligent Vehicle Highway Systems' (IVHS) or 'Intelligent Transportation Systems' (ITS)." (Order ¶ 5).

The Commission also recognizes the value of multilateration LMS communications services:

> "These narrowband transmissions are a valuable asset and may enhance the economic viability and flexibility of these particular multilateration systems." (Order ¶ 79).

MobileVision has maintained throughout the proceeding that the market should be allowed to define the nature of the services in the LMS bands in conformity with the Commission's policy objectives that spectrum be used in ways that maximize service to the public, increase consumer choice and service opportunity, foster competition, and enhance the efficient use of the spectrum. MobileVision has previously described in detail the necessity for essentially unrestricted services in order to meet the needs of IVHS/ITS goals and to serve the market demands[1] and maintains that minimal restrictions should be placed on services.

Section 90.353(a)(2), as promulgated, is both vague and difficult to regulate, either by the Commission or the licensee. The text of the Order implies a broader permissible content of the messaging as "communications necessary to provide accurate, timely and complete status and instructional information relating to the vehicle being located or the occupant(s) of the vehicle" (Order ¶ 26). Indicating that such use will be invaluable to ITS, the Order notes that the latter "will require substantial communications capacity." (Order, ¶ 26, n.59). But how does the user (occupant) define his or her "complete status"? In reality, the interpretation will

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1 Further Comments of MobileVision at pp. 13-19 and Further Reply Comments of MobileVision at pp. 14-16.

always be subjective[2] and, without an eavesdropping "content police" function, will be unenforceable, but control of the content of subscriber messages is unworkable and inappropriate. Rate structure and capacity, i.e., market forces, should dictate use, not limitations based on content.

A restriction that is appropriate and that distinguishes LMS communications from those available on other services is the requirement that location service be provided. LMS providers would not be permitted to utilize these frequencies for stand alone data or voice communications. While multilateration LMS systems are primarily location and monitoring systems, the LMS provider should not be placed at a competitive disadvantage with other providers and particularly with unlicensed Part 15 devices, by having unnecessary restrictions placed on licensed LMS services. The Order places more restrictions on the licensed LMS services than on unlicensed services. (For example, the Order notes that "Part 15 devices performing functions similar or identical to licensed LMS operations are not restricted from interconnecting with the PSN." (Order ¶ 26, n.60))

The restrictions on message content, particularly when no such restrictions apply to Part 15, will make continued investment less attractive and render the contemplated auction of MTA licenses unsuccessful. As discussed below, Part 15 services now contemplated -- which include the proliferation of equipment positioned at quarter-mile intervals blanketed throughout entire cities -- will, under the newly issued Rule, be protected from claims of interference in most instances and be permitted to provide unlimited voice and data without competition from "co-equal" LMS providers. In the absence of competitive, flexible services, considered by the public, the industry and the investment community alike to be essential, potential auction participants and potential LMS system investors will seek rewards elsewhere.

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2 Discussions with staff have not resulted in a clear and consistent view of what is permissible under the Rule's language and have underscored the vagueness of the Rule.

Therefore, MobileVision submits that the Commission should modify its definition in § 90.7 of the multilateration LMS service and system as follows (shown in bold):

> Location and Monitoring Service
>
> The use of non-voice signaling methods to locate or monitor mobile radio units. LMS systems may transmit and receive voice and nonvoice ~~**status and instructional**~~ information related to such units.
>
> Multilateration LMS System
>
> Multilateration LMS systems are land based systems that are designed to locate vehicles or other objects by measuring the difference of time of arrival or difference in phase of signals transmitted from a unit to a number or fixed points or from a number of fixed points to the unit to be located. **Multilateration systems must provide geographical location, and may provide data and voice services related to the location of the vehicle or object being monitored.**

B. Interconnection With the Public Switched Network

In the Order, the Commission has provided for limited interconnection with the Public Switched Network (PSN) by LMS providers. MobileVision agrees with the Commission that location or monitoring of a vehicle or object is a proper condition for licensed operation in the LMS bands. Conversely, MobileVision believes that interconnection with the PSN must be provided on a less restrictive basis than allowed in the Order if LMS systems are to be viable and the goals of IVHS/ITS are to be attained.

The Commission's concerns about proliferation of LMS systems and the potential interference they would create to unlicensed users are not properly balanced. When unlicensed services proliferate in the band, their effect on each other will pose much more of a threat than LMS providers will to these unlicensed services.[3] Interconnection to the PSN does not, per se, automatically lead to proliferation of LMS systems, but rather, proliferation of the band will be a natural consequence of the success of multilateration LMS systems. Since the objective for an

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3 MobileVision provided three technical papers during the proceeding on the subject of Part 15 and LMS interference proving this point. Submissions by Part 15 manufacturers have clearly stated that their devices, of necessity, have built in interference avoidance techniques in order to co-exist with other Part 15 devices. LMS systems will produce insignificant interference in comparison with other Part 15 devices.

LMS provider is to maximize its user base, it will attempt as its practical business strategy to attract as many users as the capacity of its system allows. Thus, if, as was stated in the NPRM, the continuing growth of LMS services is to be promoted, LMS service in the band will eventually be proliferated in any event independent of restrictions on interconnect to store and forward service.

Multilateration LMS systems are licensed services that must operate within the confines of their licenses and must provide location services. However, location services alone do not form the basis for a business case or provide for the requirements of ITS or other services to the public. Under the Order, however, unlicensed services that do not require the level of capital investment and resources necessary for LMS deployment and that are not restricted from interconnection (see Order ¶ 27, n.60) have superior rights and competitive advantages to licensed LMS services.

MobileVision would urge the Commission to reconsider its position on interconnection and amend the rules to allow LMS providers with unrestricted interconnection capability with the PSN. MobileVision, however, realizes that the Commission may determine not to grant unrestricted interconnection at this time, and, therefore, proposes in the alternative that, at a minimum, the service only be restricted by requiring "store and forward" interconnection to the mobile from the PSN, but permit unrestricted communication from the mobile to the PSN. Defining the services in this manner will serve the needs of the public and ITS and provide the necessary foundations for a successful auction. MobileVision does not believe, based upon conversations with industry leaders that currently serve the public with wireless communications services, that there will be a successful auction without such changes.

II. THE GRANDFATHERING PROVISIONS SHOULD BE AMENDED TO REFLECT THE PRACTICAL NEEDS FOR PROVIDING SERVICE

Multilateration LMS systems are capital intensive and require that large investments be made to effect deployment; MobileVision[4] and others have invested substantial sums in the development and deployment of multilateration LMS systems. The Commission recognized these prior extensive efforts when, in order not to impose "undue hardship," it provided for grandfathering. Unfortunately, the relevant provisions of the Order are unduly restrictive with regard to the movement and addition of sites within the area of coverage eligible for grandfathering.

In order to provide service as the number of subscribers grows (and thus to have a viable system), an LMS provider must be able to develop the coverage area grandfathered as fully as possible to offer service to the largest subscriber base. This is precisely what LMS providers do with their transmit and receive sites. In order to keep initial deployment costs to a minimum, the layout of base stations is crafted so as to minimize the number of "transmit" base stations, while still providing reasonable coverage. "Receive" base stations are strategically positioned once the "transmit" base stations' locations have been determined. (Receive only sites do not require licensing and thus can be proliferated throughout an area.) As an area is constructed, additional "transmit" base stations are added to "fill in" areas with poor coverage within the original service area because of, for example, unforeseen terrain problems. It is common to add sites to alleviate such terrain problems and thus increase the quality of service

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4 MobileVision, for example, has invested over $50,000,000 in LMS development and market research. The Commission acknowledges the capital intense nature of multilateration LMS systems:

> "...because many LMS systems will entail construction of extensive infrastructure over wide geographic areas, we also find it in the public interest to permit LMS to be offered to paying subscribers. By permitting LMS offerings to be structured as commercial subscriber based service, we afford licensees a realistic means of underwriting system development. (Order ¶ 28).

within an area of coverage. This approach is consistent with practical experience and also with the Commission's Order.

In MobileVision's case, existing licensed transmitters have been chosen to cover, for example, the area from Los Angeles to San Diego. The next step is to add receive only sites to receive mobile transmissions in order to perform multilateration. The initial coverage area, therefore, is defined as the area within which a mobile unit can properly decode and respond to forward link transmissions, and within which receive sites are strategically placed to decode the mobile's spread spectrum location "burst."[5] Under the Order, this area cannot be extended since no new transmitter sites would be permitted. However, due to terrain and other effects, it is very likely that certain areas within the originally anticipated coverage area would not be served, resulting in a poorer quality of service to the public. The necessary addition of transmit sites to alleviate this service deficiency would thus improve the quality of service to the public and need not materially expand the coverage area of an LMS provider.

The proscriptions in the Order against new "fill in" transmit sites for grandfathered licenses are extremely restrictive and do not contain sufficient flexibility for proper operation of an LMS system.[6] Since a new proceeding to determine the competitive bidding rules has not been initiated and may not be concluded for some lengthy period of time, no LMS provider would be able to provide fully reliable service within the areas it selects for grandfathering in

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5 See Order ¶ 16: "We define multilateration systems as systems that are designed to locate vehicles or other objects by measuring the difference of time of arrival, or difference in phase, of signals transmitted from a unit to a number of fixed points or from a number of fixed points to the unit to be located."

6 See Order ¶ 63. This result would not have been expected from a reading of the Commission's NPRM or the numerous comments submitted in this proceeding. As a result, it was not addressed in MobileVision's comments or those by other LMS providers nor was there extensive discussion of this issue by the Commission staff; consequently, subsequent ex parte statements filed by MobileVision and others did not address this issue in any detail.

early 1995 for an indeterminate period of time, with resulting lack of service to the public and endangering the ability of the service to function in emergency situations.

The Order effectively limits coverage areas to the licenses that exist as of February 3, 1995, and existing licensees now can only file applications to modify their existing licenses. Rather, than impose the restrictions contained in the Order, the public interest would be better served by permitting an existing licensee to add transmit sites at any time, so long as such addition is for the purpose of improving service and not substantially expanding the initial coverage area defined by existing licenses as of February 3, 1995, and in accordance with the grandfathering conditions. Since the existing transmit sites effectively define the coverage area, MobileVision requests the Commission to amend its rules as follows:

- Require existing licensees to define their coverage areas in terms of their existing transmit licenses.[7]
- Permit the relocation of a transmit site anywhere within the grandfathered coverage area requested by the LMS licensee so long as the initial coverage area is not materially expanded.
- Permit the addition of new transmit licenses anytime so long as the initial grandfathered coverage area is not materially expanded.

Adoption of the foregoing relaxation of the rules will permit the multilateration LMS licensees to provide the necessary accuracy, quality and reliability for emergency services within the original grandfathered coverage area, while at the same time alleviating concerns by the Commission about expansion beyond those areas defined during the imminent reapplication period.

III. THE EMISSION MASK REQUIREMENTS SHOULD BE RELAXED

The Order (¶ 98) specifies a formula for attenuation of out-of-band emissions by LMS systems contained in new § 90.209(m) of the rules. This specification is virtually impossible for any spread spectrum LMS system to meet and appears to be the most stringent

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7 This can also easily be calculated by application of an accepted model for propagation, e.g., the Egli or Hata Models.

emission limitations of any service. The inability to meet the specification is not a technical deficiency of a specific provider but is a consequence of the physical laws governing the processes involved in multilateration LMS systems.

During the course of the proceeding, the major multilateration LMS providers disagreed with the Commission's specification.[8] The Commission's specification effectively requires over 60 dB of attenuation of the first and/or second sidelobes, relative to the spectral peak, of digital spread spectrum transmissions, a figure that is virtually impossible to achieve. The other multilateration LMS providers (Teletrac, SMBS, Pinpoint and Uniplex) in this proceeding are in agreement with the need for relaxation of the specification and the alternative specification provided in Annex 1 to this Petition. For the reasons set forth in detail in that Annex, MobileVision urges the Commission to adopt the alternative specification for § 90.209(m) set forth therein.

IV. THE PRESUMPTIONS REGARDING PART 15 INTERFERENCE NEED TO BE REVISED AND MADE REBUTTABLE

MobileVision concurs with the Commission's statements regarding the secondary nature of Part 15 devices and supports the Commission's concept of defining harmful interference. However, the Commission used incorrect assumptions that led to the conclusions in its Order and thus created an unworkable definition. The Order states:

> "Under our rules, the transmitter output power of a Part 15 device is not permitted to be more than 1 watt. An antenna less than 5 meters in height driven by a transmitter with 1 watt or less of output power will only affect LMS operations that are relatively close." (Order ¶ 37).

The Commission then quotes Annex 1, page 4, of MobileVision's Ex Parte Comments dated August 12, 1994: "If a 6 dBi antenna is used, pointing in the direction of the LMS site, then the received signal level, at the LMS site, will be 6 dB higher than if a 0 dBi antenna were used." In this technical discussion, MobileVision simply clarified that the higher

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8 E.g., Teletrac Comments, June 29, 1993, page 50; SMBS Comments June 29, 1993, page 24.

the gain, the worse the problem and not that a 6 dBi antenna (which is the maximum allowable antenna gain in the Part 15 rules), was a suitable threshold for determining what the interference potential of a Part 15 device is, thus MobileVision's statement was used out of context. The Commission continues:

> "We conclude, therefore, that use of a Part 15 outdoor antenna with a directional gain of equal to or less than 6 dBi, or a Part 15 outdoor antenna with a directional gain of greater than 6 dBi having a proportional transmitter output power reduction, constitutes an appropriate threshold at which there is little likelihood of desensitization of the receiver(s) at an LMS site."

This conclusion, however is incorrect. The restriction on antenna height as described in the Order does not intrinsically engender significant protection for the LMS system. In fact, a one watt Part 15 transmitter at 5 meters above ground level directed at an LMS site would desensitize a site by 10 dB if it were within 4.5 miles of an LMS site.[9] Consequently, the Commission, in an effort to protect Part 15 devices, has effectively elevated their rights to that of co-equal status with LMS providers and, in certain circumstances, higher than licensed LMS services. MobileVision believes that there is no practical or legal basis for such rules.

The Part 15 community filings and ex-parte statements have expressed concerns which have been clearly addressed by the LMS industry and the LMS industry has advanced substantial evidence proving the following points:

1) Only in a few isolated cases will it be necessary to resolve an interference problem of a Part 15 device to an LMS site, and these cases are, in practice, limited mostly to field disturbance sensor devices and outdoor point-to-point links.[10]

2) Part 15 devices, operating on the same frequencies as the LMS systems, will experience less interference from LMS systems than the interference that could be expected from other Part 15 devices[11].

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9 See Table 1, Annex 1, "Ex-Parte Statement of MobileVision L.P." August 11, 1994.

10 See also "LMS Consensus Position on Part 15 Interference," June 22, 1994.

11 Reference "Interference Analysis of Part 15 Devices and LMS Systems - Initial Calculations," Annex 2, Further Comments of MobileVision, March 15, 1994.

Tables 6 and 10 show that the near-far ratios for interference to indoor Part 15 devices

The LMS providers have proposed an interference tolerance level, and the reasoning behind it, which effectively reduces the range of their mobiles by almost half.[12] This proposed threshold level was equivalent to the received interference signal being 10 dB above the theoretical noise floor."[13] Any further increase in the interference level would place a significant economic restriction on the LMS systems that would be disproportionate to the problem "solved."

The Order states:

> "Finally, because multilateration entities concur that most Part 15 interference to multilateration LMS systems is likely to be from field disturbance sensors and long range video links, we will not make any presumption of interference-free operations for these devices when they operate in exclusive-use bands." (Order ¶ 36).

Unfortunately, the new rules do not reflect this point entirely; they have excluded video links from this presumption of non-interference.

LMS systems are capital intensive and thus should be assured of an environment as free of interference as possible. Once an LMS site is chosen and constructed, factors including long site lease periods and geographical location requirements[14] render moving of the site costly and highly impractical.

Continued from previous page

are worse from outdoor Part 16 devices than LMS mobiles. Tables 13 and 15 show that the interference to outdoor Part 15 devices, from LMS mobiles, is less than that from other outdoor Part 15 devices.

It should also be noted that the transmission from an LMS mobile is very short in duration and that the probability that an LMS mobile is in the area and transmitting is very small, whereas an outdoor Part 15 device will tend to be stationary.

12 "LMS Consensus Position on Part 15 Interference," June 22, 1994 and Section 5 of "Further Analysis of Interference of Part 15 Devices and LMS Wideband Systems - Probability of Interference," G. K. Smith, June 22, 1994.

13 Thermal noise plus noise figure.

14 GDOP considerations are important to the positioning of an LMS site.

MobileVision contends that the LMS provider must have recourse to resolve such a problem, since, unlike a Part 15 device, it is a licensed service and cannot simply change its frequency of operation to avoid the interference. Even if the rules permitted, LMS providers cannot easily relocate sites without substantial lease penalties, costs to identify and obtain a new site, as well as installation and moving expenses. Moreover, pursuant to the new rules, the LMS provider may be faced with the same situation, in time, at a new site. Such recourse to resolve potential problems must also apply to the isolated event when an outdoor device meets the harmful interference criteria proposed in this Petition, but still causes significant interference, when, for example, it is situated very close to the LMS site.

It is essential in such cases that the presumption of non-interference be a rebuttable presumption so that the LMS provider, assuming it can carry the burden of rebuttal, is able to have a remedy to resolve the problem. Such scenarios will not, contrary to the assertions of the Part 15 industry, put Part 15 equipment suppliers out of business, especially since the Part 15 device will likely need only to change its frequency of operation within the remaining 18 MHz to resolve the interference.

CONCLUSION

For all of the above stated reasons, MobileVision urges the adoption of the proposed revisions to the rules regarding permissible uses of LMS, grandfathering, emission masks and interference criteria regarding unlicensed Part 15 users within the licensed band.

Respectfully submitted,

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ANNEX 1
Emission Mask Specification 90.209 (m)

SUMMARY

The new bandwidth limitations specification, 90.209 (m), for LMS systems is impossible to meet. Every LMS provider disagreed with this specification when it was proposed. The Commission has provided no reasoning to substantiate this specification and on any examination it is clear that it is totally inappropriate for a digitally modulated emission. Furthermore, it is considered preferable that a separate specification be made for the narrow band forward link transmissions. In summary the following points are made:

- in practice, the required attenuation of the first or second sidelobes needs to be over 60 dB, for any of the known LMS systems - in practice, an impossible specification to meet.

- no other emission limitation specification defines a single attenuation starting at the band edge. All other specifications allow a 'roll-off'.

- The specified resolution and video bandwidth, of 100 kHz, effectively tightens the limit by 10 dB and also makes it impossible for narrow band emissions to meet the specification, solely because of the bandwidth used for the measurement.

- The formula 55+10log(P) appears to be taken from 90.209 (l), which is for radios with 5 kHz channel spacing, and is clearly inappropriate. 90.209 (l) also specifies resolution and video bandwidths of 100 Hz or 10 kHz. Why was 100 kHz chosen for 90.209 (m) without correcting the formula to compensate for the wider bandwidth?

- There are basically two existing specifications for emission limitations. One is applied to the Maritime Service, Section 80.211, Satellite Communications, Section 25.202 Public Mobile Service, Section 22.106, and Private Land Mobile Service, Section 90.209 (c) (1). The other is for Private Operational Fixed Microwave Service and Domestic Public Fixed Radio Services, Sections 94.71 (c) (2) and 21.106 (a) (2). The latter is specifically for high speed digitally modulated emissions.

- Section 90.202 (m) represents a specification more stringent than any other emission limitation specification, including those for Domestic Public Fixed Radio Services and Private Operation Fixed Microwave Services, which are fixed site and hence can easily incorporate filtering.

The specification given in 21.106 (a) (I) and 94.71 (c) (2) represents the out-of-band limits of digitally modulated emissions for fixed site, point-to-point installations, and thus surely are stringent enough. As this specification originally applied to fixed site installations there is a good case that for mobile units, that transmit for very short periods, the limitations should be relaxed slightly. In order to accommodate a variety of chipping rates and code lengths, it is recommended that the resolution bandwidth be kept at 100 kHz. The video bandwidth should not be specified. As narrow a bandwidth as possible should be used in order to measure the mean power[1].

[1] A video bandwidth in the order of 1 kHz would be needed in order to obtain a mean power reading.

With respect to the narrowband forward link emissions, greater than 30 W ERP, it is proposed that the emission limits should be similar to that instituted for narrowband Personal Communications Services in 24.133 (a) (1) which in turn is similar to Sections 94.71 (c) (4) and 22.106 (b) (2).

Thus it is highly recommended that the following specifications be adopted for 90.209 (m):

A - For the LMS wideband emissions:

"For LMS wideband emissions, operating in the 902 -928 MHz band, in any 100 kHz band, the center frequency of which is removed from the center of the authorized sub-band(s) by more than 50 percent up to and including 250 percent of the authorized bandwidth: The mean power of emissions shall be attenuated below the maximum permitted output power[2], as specified by the following equation but in no case less than 31 dB:
A = 16 + 0.4 (P - 50) + 10 log B (attenuation greater than 66 dB is not required)

where A = attenuation (in decibels) below the maximum permitted output power level,
P = percent removed from the center of the authorized sub-band(s),
B = authorized bandwidth in megahertz."

B - For the LMS high power narrowband forward link transmissions:

For LMS narrowband forward link emissions, the power of any emission shall be attenuated below the transmitter power (*P*), in accordance with the following schedule:
i) on any frequency outside the authorized sub-band and removed from the edge of the authorized sub-band by a displacement frequency (fd in kHz): at least 116 Log10 ((fd+10)/6.1) decibels or 50 + 10 Log10 (*P*) decibels or 70 decibels, whichever is the lesser attenuation. A minimum spectrum analyzer resolution bandwidth of 300 Hz shall be used when showing compliance

1. Introduction

The specification that the FCC has imposed on the LMS transmissions[3] is extreme and effectively prohibits any of the present LMS direct sequence spread spectrum transmissions. Section 90.202 (m) represents a specification more stringent than any other emission limitation specification, including those for Domestic Public Fixed Radio Services[4] and Private Operation Fixed Microwave Services[5]. In the NPRM the Commission proposed that emissions outside of the authorized bandwidth be attenuated by at least 55 + 10log(P) dB where P is the highest emission (in watts) of the transmitter[6].

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[2] A maximum permitted output power of 30 W is assumed. Any variation in the permitted output power may require a modification to the equation.
[3] Section 90.209 (m)
[4] Section 94.71.
[5] Section 90.209.
[6] Notice at para. 30.

2. Wideband Emissions

2.1 Teletrac, Pinpoint and SBMS Original Proposals.

Not one of the LMS providers agreed with this proposed specification. Teletrac[7] and Pinpoint[8] suggested a specification of 99% of transmitted power within the allocated bandwidth, which is the same as the existing Private Land Mobile Radio Services specification 90.209 (a) and which presumably was the specification in force at the time. SBMS suggested -20 dB for the first spectral sidelobe with each following sidelobe progressively reduced by 10 dB[9], a specification that is almost the same as the 99% rule.

2.2. MobileVision Proposed Adopting Specification Similar to Sections 21.106 (a) (l) and 94.71 (c) (2).

MobileVision originally proposed a specification similar to that for the Maritime Service, Section 80.211, Satellite Communications, Section 25.202, Public Mobile Service, Section 22.106, and Private Land Mobile Service, Section 90.209 (c) (1), but with attenuation limits of 35 dB and 50 dB for frequencies removed 50-100% and >100%, respectively[10]. MobileVision subsequently pointed out that the only specifications that were written for high speed digital modulation were for the fixed microwave services. In fact both the public and private services have the same specification and are given in Sections 94.71 (c) (2) and 21.106 (a) (2). MobileVision proposed that this specification be accepted, with minor amendments[11]. Bearing in mind that this specification was written for fixed site, point-to-point links, where site filtering does not present a problem, it represents a significantly more stringent specification when applied to a mobile transmitter. Therefore it is proposed that the specification be slightly relaxed.

2.3. Section 90.209 (l) is only specification using (55 + 10 log P) formula

In searching through all the Sections referring to emission limitations, the only one found that specifies the (55 + 10 log P) formula is in Section 90.209 (l) which is for "transmitters that operate on 5 kHz channel assignments in the 220-222 MHz frequency band". In 90.209 (l) the resolution bandwidth is specified as 100 Hz for measuring up to 250 kHz from the edge of the band and 10 kHz beyond that. This rule, 90.209 (l), appears to have been used as the basis for the new rule 90.202 (m), in that the wording is almost identical, but the significant difference is that 100 kHz resolution bandwidth has been substituted in the new rule, without any compensation for the wider bandwidth.

2.4. The Video Bandwidth specification in practice tightens the limit by 10 dB.

It is specified, in 90.202 (m) that the video bandwidth of the measuring instrument must also be 100 kHz, a fact that effectively makes the specification about 10 dB more stringent due to noise of the measuring system. The envelope is effectively 10 dB higher due to the wide video bandwidth because it is measuring the peak power and hence the sidelobe attenuation must be effectively 10 dB better. This is easily proved by simply displaying the emission on a spectrum analyzer and

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[7] Teletrac Comments, June 29, 1993. p 50.

[8] Pinpoint consistently assumed 99% throughout the proceeding, e.g. Reply Comments, July 29, 1993, Appendix B, p.31.

[9] SBMS Comments, June 29, 1993, p.24

[10] Comments, June 29, 1993, Annex A, p.20.

[11] Further Comments, March 29, 1994, Annex 3, and Ex-Parte Statement, August 11, 1994, Annex 2

changing the video bandwidth between, say, 100 kHz and 1 kHz. In order to measure the mean power it is necessary to reduce the video bandwidth. The video bandwidth is the post detection bandwidth and it is standard practice to use a narrower bandwidth to average the signal. It is therefore recommended that no limit should be placed on the video bandwidth.

2.5. Required Attenuation, Sidelobes and Allocated Bandwidth

The Commission must understand that the spectral envelope of the spread spectrum emission is one consisting of a main lobe and successive sidelobes, as is the envelope of any high speed digitally modulated emission. Techniques for reducing the sidelobes are often employed, but, especially for a mobile unit, there is a cost restraint. In examining C.F.R. 47, every emission limitation specification allows for a 'roll off'. The proposed new 90.209 (m) specification is unique in not allowing any roll off.

If the allocated bandwidth is 5.5 MHz then the peaks of the first sidelobes will be just outside the band edges and hence will need to be attenuated by 52 dB[12] in order to meet the existing 90.202 (m) specification. In fact, because of the previously mentioned effect of a 100 kHz video bandwidth, the first sidelobes would need to be over 62 dB down on the peak in order to meet the specification. This is impossible. If the allocated bandwidth were 8 MHz, the first sidelobes would be within the allocation and hence, in order to meet the specification, the second sidelobes would need to be over 62 dB down. Again an impossible specification.

Using the published chipping rates of the LMS systems, the corresponding results are:

	Chipping Rate, Mcps	*Power W*	*Practical Attenuation Required, dB*
SBMS	1	10	65
Teletrac	1.5	10	63
Pinpoint	5.768	30	62
MobileVision	2	10	62

An attenuation requirement of over 60 dB on the first or second sidelobe represents, in practice, an impossible specification to meet for a cost effective mobile radio[13].

2.67. 90.209 (m) represents an impossible specification and the Commission is strongly urged to reconsider.

In short the new specification as given in 90.209 (m) effectively prohibits any of the present LMS direct sequence spread spectrum transmissions. In order to meet the specification, the chipping rates would have to be reduced drastically such that the performance of the systems would change dramatically for the worse.

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[12] For a 2 Mcps chipping rate, the noise bandwidth is 2 MHz. The power measured in a 100 kHz bandwidth will be reduced by 10 log 2000/100 = 13 dB i.e. the level on the spectrum analyzer will be 13 dB lower. Thus, measured in a 100 kHz bandwidth, the theoretical required attenuation of the sidelobes, relative to the peak of the main lobe, is: 55 + 10 log 10 - 13 = 52 dB.

[13] Filtering of the pulse sequence can reduce the sidelobe levels but when amplified the sidelobe levels become higher again. In a cost effective mobile installation the cost and size of the necessary filtering that would be required would be totally prohibitive.

The "55 + 10 log P" formula was not and is not applicable to digitally modulated emissions. It has only ever been applied to 5 kHz channel radios and even then it does not exclusively start at the band edge[14]. Furthermore a single attenuation starting from the band edge has not been applied to any other system. The 100 kHz resolution and video bandwidth is wrong because it can artificially increase the limit by about 10 dB. In addition, because the specification allows for no roll-off at all, it makes it impossible for any narrow band transmissions to meet the limits. For example, a narrow band emission would be artificially made wider on the spectrum analyzer display, simply because of the wide resolution bandwidth. Hence any narrow band emission, even a clean carrier, near the edge of the band, would fail the specification.

2.7. Specification based on 21.106 (a) (I) and 94.71(c) (2) is proposed.

The Commission should base the specification upon an existing specification, preferably one for digitally modulated emissions. The specification given in 21.106 (a) (I) and 94.71 (c) (2) represents limits for fixed site, point-to-point installations, and thus, surely, are stringent enough. As this specification originally applied to fixed site installations there is a good case that for mobile units, that transmit for very short periods, the limitations should be relaxed slightly.

The emission limits given in 21.106 (a) (I) and 94.71(c) (2) are that, in a 4 kHz bandwidth, the mean power of emissions shall be attenuated below the mean output power, as specified by the following equation, but in no case less than 50 dB:

$A = 35 + 0.8 (P - 50) + 10 \log B$ (attenuation greater than 80 dB is not required)

where P is the percentage removed from the center of the band

and B is the authorized bandwidth.

The above specification is for fixed site, point-to-point links and when applied to a mobile transmitter that only transmits periodically, and where it is not practical to use extensive RF filtering, it is suggested that the specification formula should be relaxed slightly to:

$30 + 0.4(P-50) + 10 \log B$, with a minimum of 45 dB, and maximum 80 dB.

In order to accommodate a variety of chipping rates and code lengths, which can result in relatively widely spaced spectral lines, it is recommended that the measurement bandwidth be changed from 4 kHz to 100 kHz[15]. This effectively means that the attenuation should be relaxed by 14 dB[16]. Thus it is proposed that the specification should take the form of

$A = 16 + 0.4(P-50) + 10 \log B$, minimum 21 dB, maximum 66 dB.

Figure 1 shows the theoretical attenuation relative to the spectral peak of an emission as given on a spectrum analyzer. The required attenuations are given for:

a) the proposed specification $A = 16+0.4(P-50)+10\log B$, (min. 21dB, max 66dB) measured in a 100 kHz resolution bandwidth,

b) specification as per 21.106(a) (I), measured in a 4 kHz resolution bandwidth,

and c) 55+10logP measured in a 100 kHz resolution bandwidth.

In all the above, the mean power is assumed, i.e. a narrow video bandwidth.

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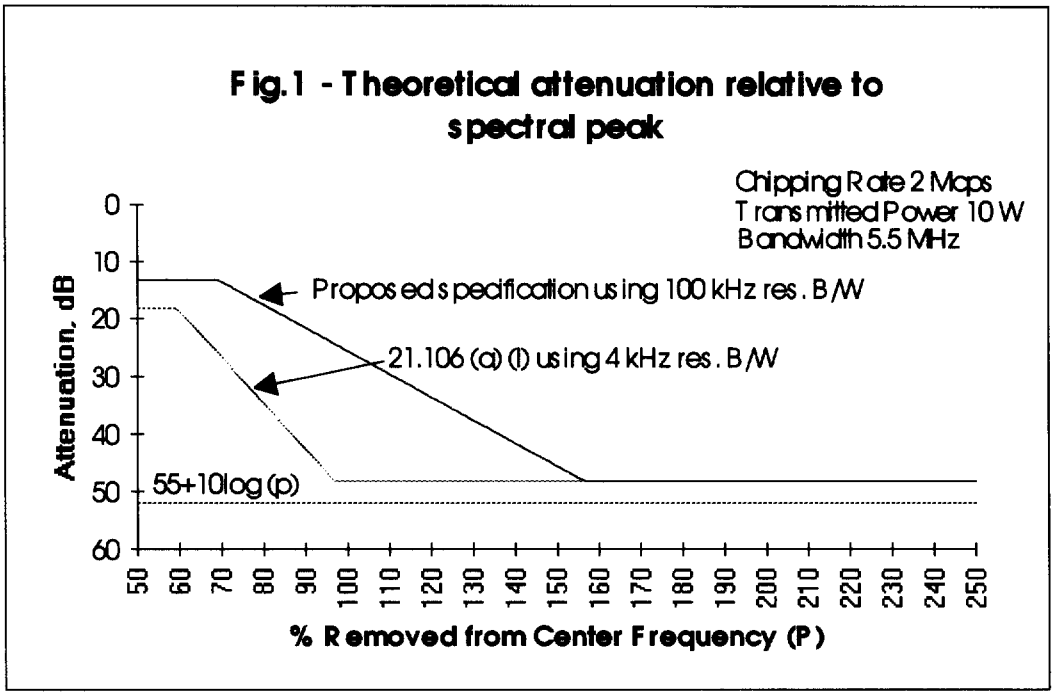
[14] 90.202 (l) (2) allows the lesser of 30+20(fd-2) dB, (which is 40 dB at the band edge), or 55+10logP or 65 dB.

[15] Pinpoint's system, for example, has spectral lines about 90 kHz apart.

[16] 10 Log (100/4) = 14 dB



It should be noted that for P>150 % the proposed specification is similar to the present specification.

3. Narrowband Forward Link Emissions

LMS systems are authorized to emit narrow band forward links at up to 300 W within separate 250 kHz bands. As these transmissions are different from the wideband it would seem sensible to apply a separate emission limit specification to them. Given the relatively narrow bandwidth and the high power authorized in the narrowband forward link sub-bands, a more stringent specification would appear to be appropriate. It is proposed therefore, that the emission limits should be similar to that instituted for narrowband Personal Communications Services in 24.133 (a) (1)) which in turn is similar to Sections 94.71 (c) (4) and 22.106 (b) (2).

Figure 2 shows the theoretical attenuations, relative to the spectral peak for a 300 W, narrow band channel at the edge of the sub-band, for emission limits as per:

a) sections 22.106 (a), 25.202 (f), 80.211 (b), and 90.209 (c)[17]
b) the proposed "wideband" specification if were also applied to the narrowband channels (figures relative to 30W)
c) the proposed narrowband specification,
116Log((fd+10/6.1) or 50+10LogP or 70 dB, whichever is the least
d) the present specification of 55+10 LogP.

From figure 2 it can be seen that the proposed specification requires a relatively steep roll-off and will effectively provide good protection for users in the adjacent bands.

[17] 25 dB for 50-100% and 35 dB for 100-250%.